# Bisection and Secant Methods: To bracket or not to bracket

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## Introduction

Consider the rootfinding problem with $f(x) = 3(x+1)(x-1/2)(x-1)$ on the interval $-1.25 \le x \le 2.5$.

Though the code is omitted, the results below are reported for the example problem above addressing the application of secant method and comparisons to Newton's method and the bisection method.

## Bisection Method

On the interval $-1.25 \le x \le 2.5$, solutions to $3*(x+1)*(x-1/2)*(x-1) = 0$ are given by the following.

```
bisect(function(x)3*(x+1)*(x-1/2)*(x-1), a=-1.25, b=2.5, k=5)
```
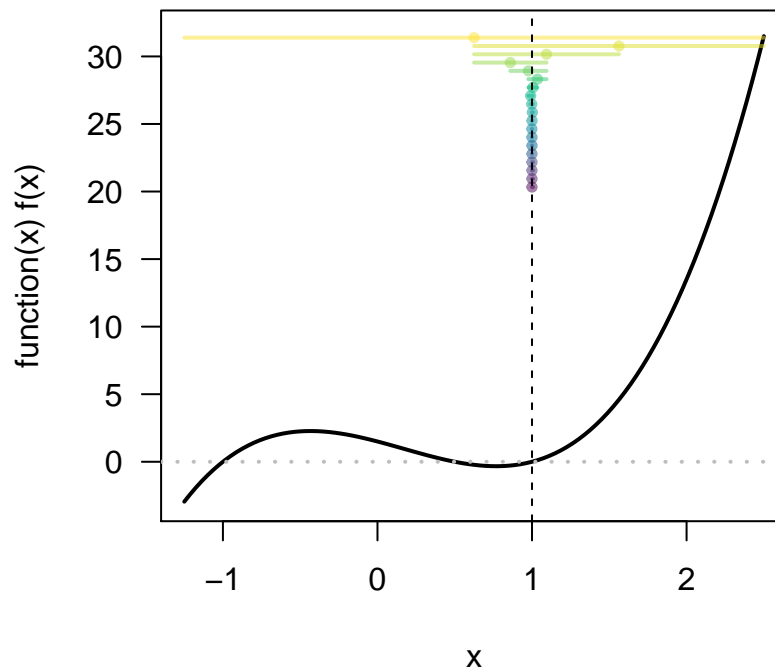


```
##          [,1]          [,2]          [,3]          [,4]
## [1,]     1 -1.2500000000 0.6250000000 2.500000000
## [2,]     2  0.6250000000 1.5625000000 2.500000000
## [3,]     3  0.6250000000 1.0937500000 1.562500000
## [4,]     4  0.6250000000 0.8593750000 1.093750000
## [5,]     5  0.8593750000 0.9765625000 1.093750000
## [6,]     6  0.9765625000 1.0351562500 1.093750000
## [7,]     7  0.9765625000 1.0058593750 1.035156250
## [8,]     8  0.9765625000 0.9912109375 1.005859375
## [9,]     9  0.9912109375 0.9985351562 1.005859375
```

```
## [10,]   10  0.9985351562 1.0021972656 1.005859375
## [11,]   11  0.9985351562 1.0003662109 1.002197266
## [12,]   12  0.9985351562 0.9994506836 1.000366211
## [13,]   13  0.9994506836 0.9999084473 1.000366211
## [14,]   14  0.9999084473 1.0001373291 1.000366211
## [15,]   15  0.9999084473 1.0000228882 1.000137329
## [16,]   16  0.9999084473 0.9999656677 1.000022888
## [17,]   17  0.9999656677 0.9999942780 1.000022888
## [18,]   18  0.9999942780 1.0000085831 1.000022888
## [19,]   19  0.9999942780 1.0000014305 1.000008583

## [1] 1.000001431
```

## Secant Method

On the interval $-1.25 \leq x \leq 2.5$, solutions to $3 * (x + 1) * (x - 1/2) * (x - 1) = 0$ are given by the following.

```
secant(function(x)3*(x+1)*(x-1/2)*(x-1), a=-1.25, b=2.5, p0=2.5, p1=2, k=5)
```
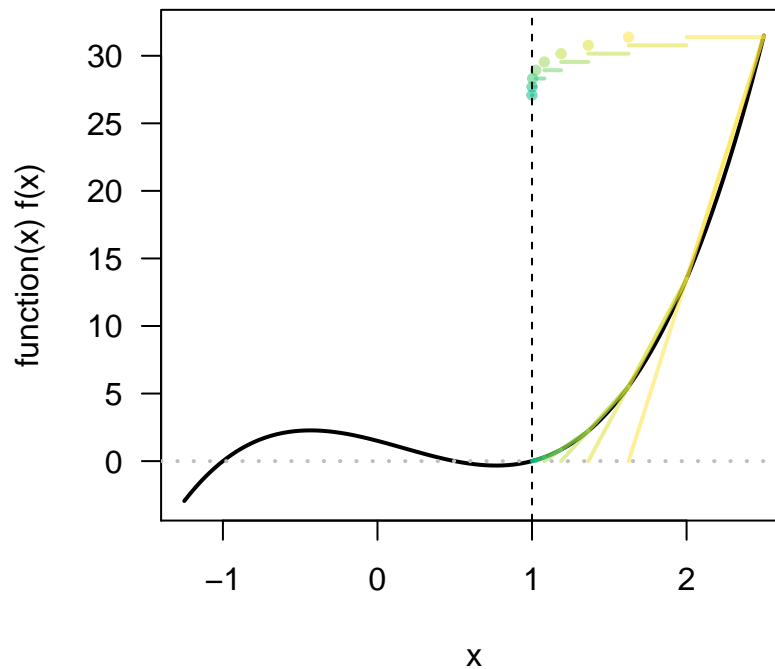


```
##        [,1]         [,2]         [,3]
## [1,]    1 2.000000000 1.625000000
## [2,]    2 1.625000000 1.364238411
## [3,]    3 1.364238411 1.188047870
## [4,]    4 1.188047870 1.079879551
## [5,]    5 1.079879551 1.024080827
## [6,]    6 1.024080827 1.003947783
## [7,]    7 1.003947783 1.000224447
## [8,]    8 1.000224447 1.000002196

## [1] 1.000002196
```

# Newton's Method

On the interval $-1.25 \leq x \leq 2.5$, solutions to $3 * (x + 1) * (x - 1/2) * (x - 1) = 0$ are given by the following.

```
newton(function(x)3*(x+1)*(x-1/2)*(x-1), function(x)3*((x+1)*(x-1/2)+(x+x-1/2+1)*(x-1)), a=-1.25, b=2.5
```
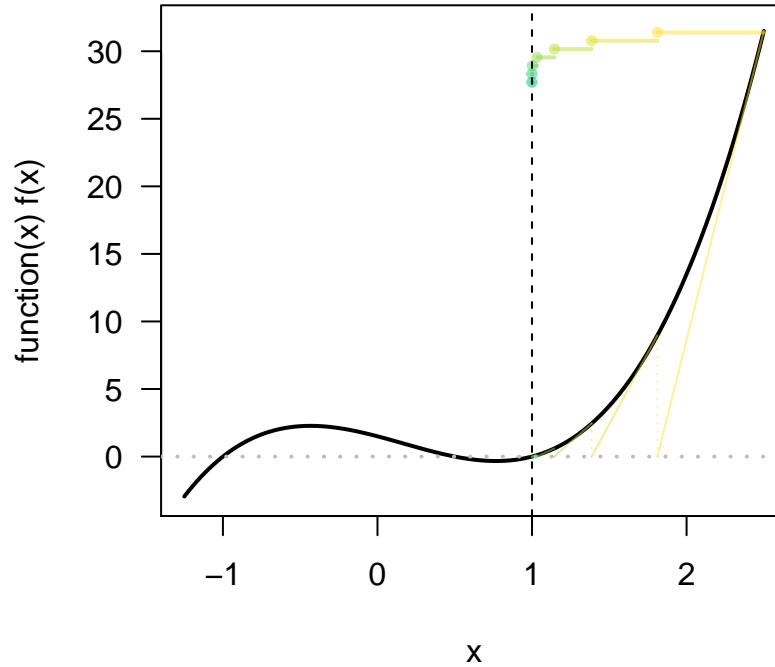


```
##          [,1]          [,2]
## [1,]       1 1.811475410
## [2,]       2 1.386035528
## [3,]       3 1.144382426
## [4,]       4 1.032578864
## [5,]       5 1.002334846
## [6,]       6 1.000013496
## [7,]       7 1.000000000

## [1] 1
```